NOTES
ON THE
GEZIRA IRRIGATION PROJECT

THE ANGLO-EGYPTIAN SUDAN.

·JANUARY · 1926·

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GEZIRA IRRIGATION SCHEME (SUDAN)
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Notes

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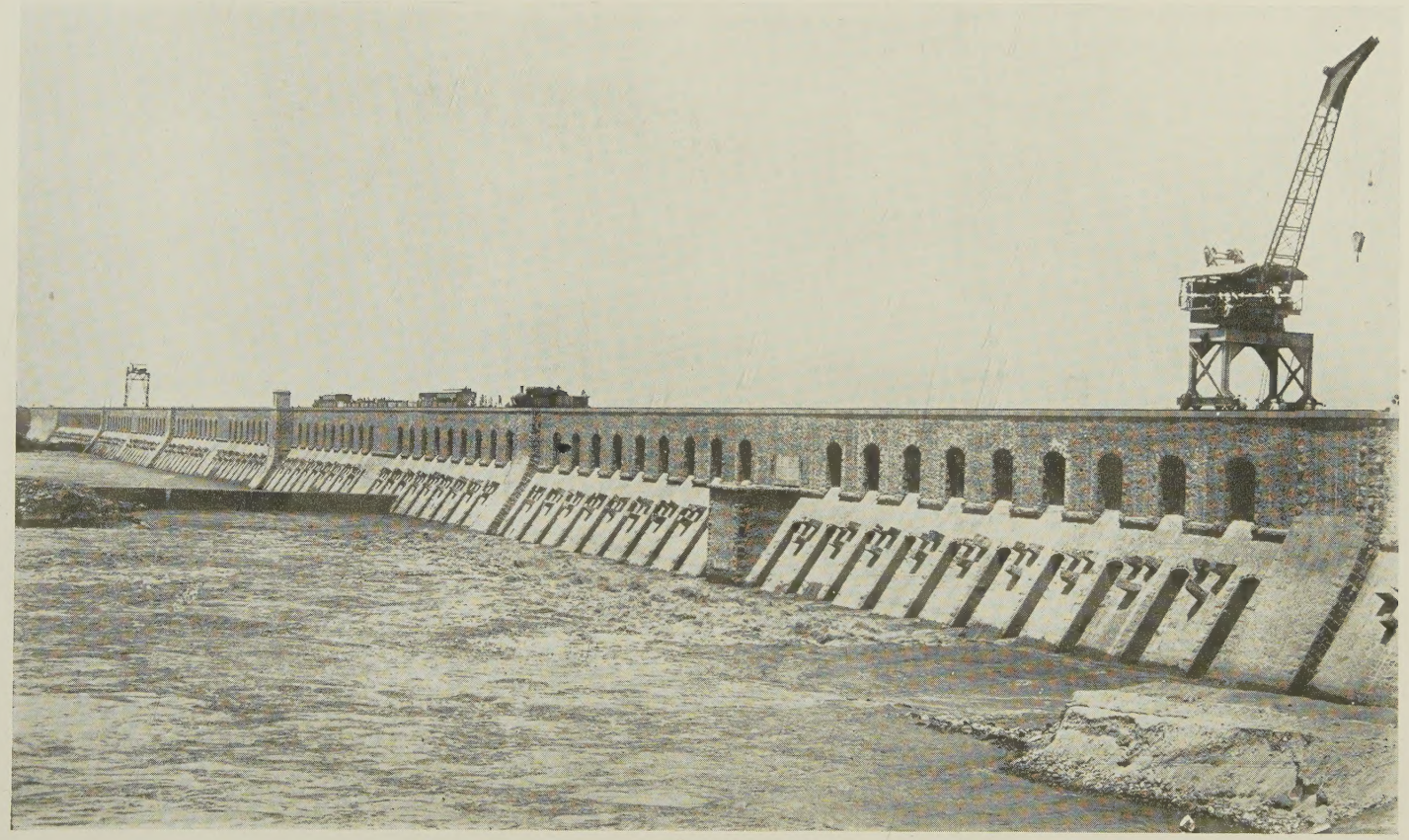
JANUARY, 1926.

McCorquodale & Co., Ltd., London.



SENNAR DAM.

CHAPTER I.

Descriptive and Historical.

THE Gezira embraces roughly the triangular tract of country lying between the Blue and White Niles, with its apex at Khartoum, and its base along the railway line from Sennar to Kosti. (Note.—The word Gezira means "Island," and this tract of country has received the name because it is almost surrounded by the two Niles.)

There is reason to believe that at one time the Gezira formed part of a Christian Kingdom, and remains of a Christian Church are still to be seen at Soba, on the east bank of the Blue Nile, a few miles south of Khartoum.

From the end of the 15th century until 1821, the Gezira was under the Government of the Fungs. The Fung Sultan lived at Sennar and was known as the Sultan of Sennar or the "Sultan Azrak" (the Blue Sultan), and his Government was known as the Sultana Zarga (the Blue Sultanate). The Arabic word "Azrak," as used in the Sudan, can mean either black or blue, so that it is a moot point whether the Sultan was called "Azrak" because the Nile is blue or because his people were black.

Amara Dongis, the first Sultan of the Fungs, commenced his rule in 1485, and founded Sennar, the Fung Capital on the Blue Nile.

At the beginning of the 16th century, the dominions of the Blue Sultans came to be of vast extent. How far south they extended is uncertain, but they included Kordofan to the west and Dongola to the north, while the tribes occupying the territory between the Nile and the Red Sea and Abyssinian border were all tributary to the Blue Government. Monsieur Poncet, who visited Sennar in 1699 with Father Xaverius de Brevedent, found there a population of

nearly a hundred thousand and a very considerable trade. So important was the export of cotton that the Sultan, by consent of the King of Ethiopia, kept an officer of customs at Chelga to receive the duties on cotton which was brought into Ethiopia. The duties were equally divided between the two princes.

Burckhardt, who was at Shendi in 1814, mentions that the principal export from Sennar was damur or cotton stuff, which was then in use not only along the banks of the Nile as far as Dongola, but also in Kordofan, a great part of Darfur and Abyssinia, and throughout the whole of Nubia east of the Nile as far as the Red Sea. He also states that the cotton manufactories of Sennar and Bagirmi, on the west of Darfur, furnished the greater part of North Africa with articles of dress. But, though trade continued to prosper, the dynasty by the end of the 18th century was in its dotage, and in 1821, the advance of the Turkish Army, under Ismail Pasha, was unopposed, after the power of the Turkish rifles to pierce the shields of the Fungs had been demonstrated.

Under the Turco-Egyptian rule the Gezira, as far south as Wad Medani, was part of the Province of Khartoum. During this period taxation became arbitrary and oppressive, and the slave trade, of which Mesellemia was the centre, was the only form of trade which flourished. According to Gessi Pasha more than 400,000 women and children were taken from their native country between the years 1860 and 1874 and sold in Egypt and Turkey, while Sir Samuel Baker put the figure even higher, estimating that at least 50,000 slaves were captured annually during the years immediately preceding his expedition to suppress the slave trade in 1869.

When the Mahdist rebellion broke out the Gezira tribes, with few exceptions, followed Ahmed Wad Ali el Taishi under the black flag of Yacoub. Fighting in the Gezira was centred chiefly round Sennar where the Turco-Egyptian garrison, under Abdel Nur Bey, for a long time resisted all attacks of the Dervishes, and was not subdued until August, 1885, after the fall of Khartoum.

During the Mahdia the Gezira was a district of very great importance as a source of grain supply for the Khalifa's army and for those crowded in Omdurman.

In 1886 the Khalifa summoned the inhabitants of the Gezira to Omdurman, so that in 1886 and 1887 the country was deserted. Owing to the difficulty of feeding so many people in Omdurman they

were allowed to return in 1888, the year of the great famine. Apart from a heavy tax on grain, an annual tribute on cotton was levied on the Gezira, which eventually reached 100,000 rolls of cotton cloth a year. But, as the number of rolls demanded increased, the size of the rolls supplied decreased, so that the tribute was not quite so formidable as it sounds.

After the reconquest of the Sudan, in 1898, the Gezira district settled down once again to conditions of political stability.

RAIN DURA.

CAMELS ON GEZIRA PLAIN.

CHAPTER II.

The Development of the Gezira.

THE appearance of the Gezira is familiar to every traveller by train south of Khartoum. The monotony of the flat unending plain is only occasionally broken by a clump of trees or a village of straw huts. It would be difficult to imagine a stretch of country of more unpromising aspect.

The plain contains about five million feddans, of which it should be possible to irrigate three million. It will, therefore, be seen that the 300,000 feddans, which is the area to be irrigated under the present scheme, is one-tenth of the total area which could be cultivated by artificial means.

The effect of the change wrought by artificial irrigation can only be appreciated by comparison with those parts of the Gezira which are still untouched. Where once stretched mile after mile of dark and dusty soil, bounded only by the distant mirage, the eye may now rest on vast fields of green cotton plants.

The staple crop of the Gezira grown by rain cultivation has from time immemorial been dura, and the Gezira has always been regarded as the granary of the whole Sudan.* But the rains are precarious, both in their volume and their distribution, and the inhabitants have in the past always been subject to the risk of famine and starvation. Under the Khalifa's rule thousands perished in certain famine years, and even in 1913-14 it was only by imports of grain from India by the Sudan Government that a serious famine was averted.

Under these uncertain conditions cultivation had been carried on to a varying extent each year, and individual rights to cultivate various areas had gradually been established.

* The average annual production of the whole triangle bounded by the Sennar-Kosti Railway and the White and Blue Niles over a recent period of 12 years was about 126,000 tons worth perhaps £E.600,000.

In order properly to understand the situation it is essential to realise that any picture taken from European ideas of each man living on his own bit of land, which he cultivates, is quite mistaken. In the past the cultivators have either lived in villages grouped round wells, often at some distance from their cultivation area, or carried on pursuits in other parts of the Sudan, only coming on to the land for the short period of rain cultivation.

Attention was first called to the possibility of irrigation in the Gezira by Sir William Garstin's report, published with Despatch No. 2, 1904, from His Majesty's Agent and Consul-General in Cairo to the Foreign Office. As a result of this report a Sudan branch of the Egyptian Irrigation Service was established and, in December, 1904, a survey party commenced the work of taking levels of the area, and a systematic study of the whole problem was entered upon. But many important steps had to be taken before a large irrigation scheme could be started. First it was clear that existing native rights could not be properly protected unless a register of ownership of the land was available. This was in fact begun in 1906 as part of the normal Government policy, by Mr. H. St. G. Peacock, whose report on the Land Settlement of the Gezira has been extensively used in the compilation of this note. Secondly, for any large scheme, adequate means of transport were necessary. The second great step towards the development of the Gezira was the construction of a railway, which was begun in 1909, and reached Sennar in 1910.

The third step was to ascertain by experiment what were the prospects for the successful cultivation of cotton grown under artificial irrigation, and for this purpose a stretch of land was acquired by Government at Tayiba and a pump erected there. So successful were the results of this project that the area was extended, and the growing of long staple cotton was found to be sufficiently remunerative to justify a much larger outlay of capital with every prospect of a beneficial return.

2. LAND SETTLEMENT.

The immediate object of Land Settlement in the Gezira was to obtain a Register of Title. In this it differed from the early settlement schemes in India, in which registers were specially intended for revenue purposes.

The work of Land Settlement in the Gezira was carried on jointly with a Cadastral Survey, but before this work was commenced, the Director of Surveys and his advisers, taking into consideration the level nature of the country and the local conditions, prepared a scheme for dividing the districts into approximate squares of equal areas, the sides of which are minutes of latitude and longitude. The skeleton survey made under this scheme by Mr. Crompton and Mr. Vines has proved a most admirable framework for the later work of a detailed Cadastral Survey, and for the formation of a register of ownership, both simple and complete, on a system never previously carried into effect in any country. At every minute of latitude and longitude, iron poles or beacons have been erected with cross vanes, on which are stamped the degrees and minutes of latitude and longitude. Twenty-five minute squares, approximately twenty-five square miles, form a registration unit or section, and a separate map for each minute square on scale $\frac{1}{4000}$ is produced by the Cadastral Survey Party.

It was arranged that the lands in the districts of Wad Medani, Mesellemia and Kamlin, on the west bank of the Blue Nile, should be first dealt with, and settlement work was first begun in Mesellemia district in April, 1906.

In the face of many obstacles and under very trying conditions, the greater part of the settlement was completed in 1912. The comparatively small number of disputes in respect of registered land which have arisen since the settlement, is ample testimony to the thoroughness and accuracy with which the work was carried out.

3. EXPERIMENTAL PROJECTS.

As stated above, the first experimental project was at Tayiba. In 1911 the Government erected a pump and canalised about 3,000 feddans—later increased to 5,000 feddans—for the purpose of carrying out experiments to ascertain what crops, &c., were most suited to irrigation in the soil and climate of the Gezira. The whole area was rented from the owners at 5 P.T. a feddan and relet to the tenants in 30 feddan blocks.

The management of this area was entrusted by the Sudan Government to the Sudan Plantations Syndicate, Ltd. The Syndicate were already interested in a concession from the Government for the growing of cotton, with pump irrigation at Zeidab, in

the Province of Berber, north of Khartoum, where they had obtained valuable experience in the type of work required. Some of the Syndicates' tenants from Zeidab were introduced to help to start the new experiment at Tayiba.

At the commencement of this experiment the tenants were charged a fixed rate for the supply of water. The Syndicate were appointed as managers until such time as the experiments should be proved a success.

By 1913 success appeared assured, and it was clear that a bigger project could be considered. It became necessary to find some more permanent basis for co-operation between the Government, the Syndicate, and the native cultivators ; and after careful discussion and consideration, in which Lord Kitchener, then the British Agent-General in Egypt, took a prominent part, it was decided to introduce the profit sharing arrangement, which has since become the basis for the whole Gezira scheme. The Sudan Government were to be responsible for the financing and running of the pumps, and having also supplied the capital for the " major " canalisation. The Syndicate became responsible for the " minor " canalisation, for management of the whole enterprise, and for financing the tenants. The tenants themselves were to supply the labour as cultivators. The cotton crop was to be divided into portions of 35 per cent. to the Government, 25 per cent. to the Syndicate, and 40 per cent. to the tenants, while other crops were all to go to the tenant. The results of this decision have been very far reaching.

As things have turned out it has provided the only possible method by which a return could have been obtained on the large amount of capital that has ultimately been required for the Gezira scheme. Any fixed charge that would have given a reasonable return must have been heavier than the man with bad crops could stand, and less than the man with good crops could afford, while the amount of the fixed charge would have appeared very frightening to the tenant. It has encouraged the provision of careful supervision, owing to the Government and the Syndicate being directly interested in the actual results, and has produced conditions believed to be different from any other irrigation scheme in the world.

Simultaneously with these new arrangements at Tayiba, the project for the larger scheme had taken shape, and its main lines were settled after a visit to the Sudan by Lord Kitchener, with his expert

advisers, at the end of 1913. It was settled then that the canalisation should be undertaken of about 300,000 acres, of which 100,000 was to be under cotton, and that a dam was to be built at a point near the village of Sennar across the Blue Nile, so that irrigation by gravity would take the place of irrigation by pumps.

In order to carry out this project substantial funds would be required. Lord Kitchener had already approached the British Government on this question, and in 1913 the first Sudan Loan Act was passed authorising the British Treasury to guarantee a Sudan Government Loan for £3,000,000, raised for financing the Gezira scheme and other projects. Preparatory work was actually started for the construction of the dam in 1914, but was stopped on the outbreak of the Great War. The further history of the construction, and of the financing of the project, is more fully dealt with below.

When the larger schemes had been decided on in 1913, as explained above, it appeared essential that a second experimental station should be started in another part of the area in order that conditions could be tested more fully than was possible at a single station. It was then arranged, again chiefly at Lord Kitchener's instigation, who was throughout deeply interested in the Gezira project, and a firm believer in its possibilities, that the Sudan Plantations Syndicate should erect a pump and canalise about 6,000 feddans at Barakat at their own expense, and run it as an experimental station until the arrival of gravitation water. This was done, and in the autumn of 1914 irrigation began on this new area.

The above two schemes may be regarded as the preliminary experiments. As a result of the experience gained from these, it was possible to settle the main lines for developing the larger scheme. It had become clear that the work of "managing" the whole business on the agricultural side—training and supervising the tenants, seeing to the digging of the field channels and the clearing of the ground, carrying out the levelling and the ploughing, supervising the sowing and growing of crops, making advances to the tenant-cultivators to cover their working expenses during the early part of the year before the proceeds of sale of cotton come in, arranging for the collection, sorting, ginning and marketing of the crop, &c., required a large and elaborate organisation. It also required the provision of large sums of money for expenditure on fixed plant and staff, and for financing advances to the tenants.

The responsible authorities decided that the task of " management " was beyond the resources of the Sudan Government, which had already to undertake the building of the dam and the construction of the main canalisation, and the Sudan Plantations Syndicate was, accordingly, invited to participate as partners in the final scheme.

Negotiations were carried on from 1913 onwards, and finally the present comprehensive concession agreement was settled in 1919. In the meanwhile the Sudan Plantations Syndicate had carried on their work at Zeidab, Tayiba and Barakat in spite of great difficulties throughout the war, and this period of four years, instead of being wasted, furnished a mass of valuable experience for settling the details of the larger scheme.

At the close of the war active steps for further extensions were taken. Fresh arrangements for raising capital were necessary as the rise of prices since the war made a considerable increase in the cost of construction inevitable. As a result a new Sudan Loan Act was passed by the British Government, increasing the amount to be guaranteed from £3,000,000 to £6,000,000, and with this fund secured the construction work was restarted. Further, the experience gained in the preliminary experiments made it possible to settle the lines of legislation required to safeguard the interests of the native landowners affected, and the Gezira Land Ordinance (explained more fully below) was drafted and finally passed in 1921.

At the same time, as noted above, the final concession agreement with the Syndicate was concluded, and attention was then turned to taking further measures to prepare for the inauguration of the full project.

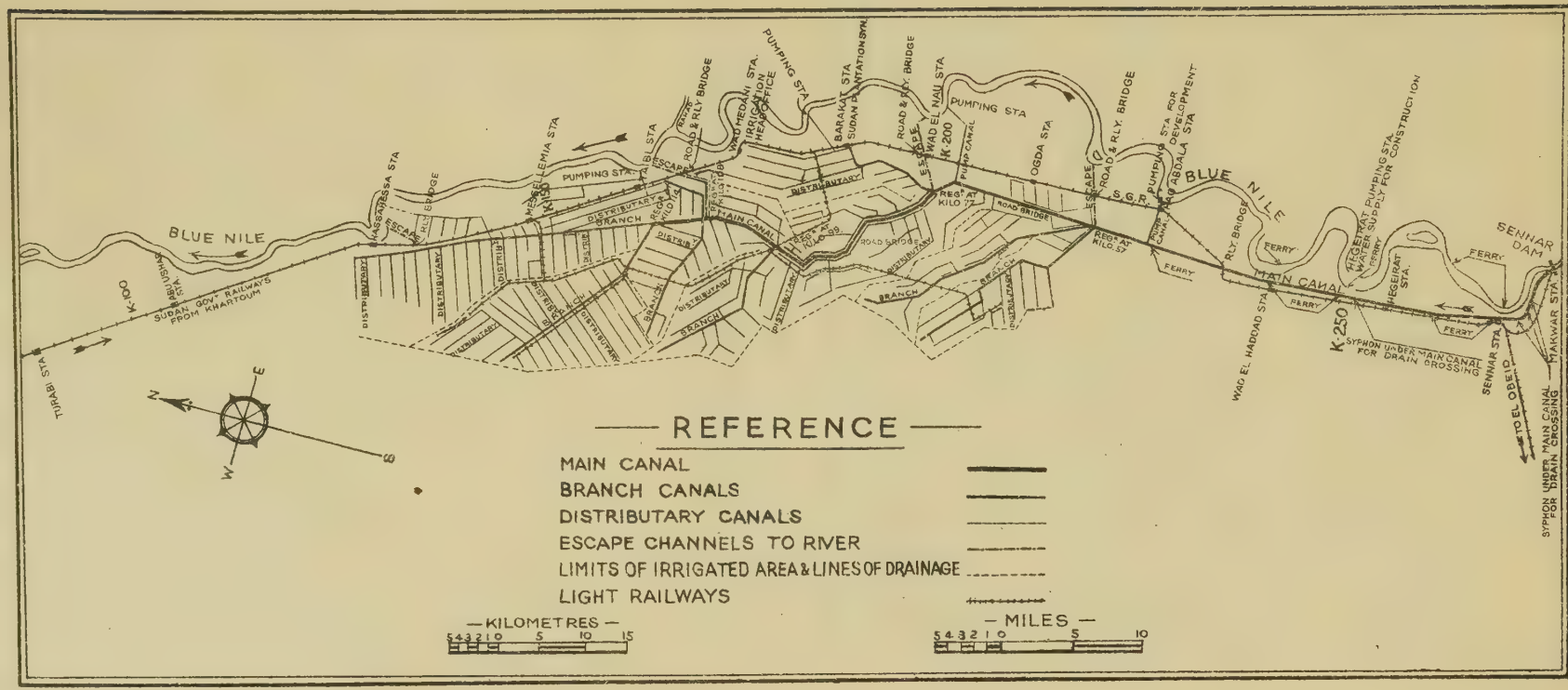
The two preliminary schemes at Tayiba and Barakat had, as mentioned above, given most valuable experience, but both the Government and the Syndicate realised that this was not enough. If the full area of 300,000 acres, with 100,000 acres under cotton, was to be brought under cultivation as soon as the dam and canalisation were completed, it was of vital importance to get as many British inspectors and native cultivators as possible trained in advance. The Syndicate for this reason undertook two further large pumping schemes within the area. On the first, at Hosh (19,500 acres, with 6,500 acres under cotton), cultivation was started in the season 1921–1922, and on the second, at Wad el Nau (30,000 acres, with 10,000 acres under cotton), in the season 1923–1924.* In taking

* Incidentally these two pumping stations have also been supplying the quantities of water required for various purposes during the carrying out of the work of canalisation over the whole 300,000 feddan area.

GEZIRA CANALISATION SCHEME

LAY-OUT OF CANALS

FOR 300,000 FEDDANS



these steps the Syndicate expended large sums on the pumping installation with the knowledge that as soon as the dam and main canalisation were completed the pumps would no longer be required, but their bold policy has been amply justified by its results.

The dam and main canalisation for the big scheme was completed, according to contract, by Messrs. Pearson, in July, 1925, and on July 15th irrigation was commenced from the reservoir above the dam. The preparations made by the Syndicate, as explained above, bore fruit, and in the first season they have been able to allot tenancies for 240,000 acres, of which 80,000 acres have been actually sown with cotton and watered, while the tenants have further been allowed to plant up to 40,000 acres of dura and 40,000 of lubia.* The maximum area under cotton with the pumping schemes had been 20,000 acres, and the expansion in one season from this to 80,000 has been a remarkable achievement, which would have been impossible without the pioneer work of the Syndicate. The areas canalised for the pumping schemes at Tayiba, Barakat, Hosh and Wad el Nau have been incorporated in the main area, and as the water now flows by gravity from the reservoir above the dam, the pumps have ceased to work.

* The above areas for dura and lubia represent the proportion of those crops to cotton decided on for the general scheme. Actually the areas under these crops are less this year owing to the inexperience of tenants and the necessity of keeping water requirements for crops other than cotton low until the system is in full working order. The actual areas in the present season are approximately 34,000 dura and 6,000 lubia.

CHAPTER III.

The Main Gezira Scheme.

THE area known as the Main Gezira Area, most of which has been irrigated by gravitation water from the Sennar Dam in 1925, comprises 300,000 feddans. It starts from a point 57 kilos north of Makwar, near Hag Abdulla, and runs northwards parallel with the river and mainly west of the railway to Hassheissa. The block is some 85 kilos long, south to north, and 14 to 25 kilos wide, east to west, with an average width of some 18 to 19 kilos, being rather narrower at the extreme south and at the north end.

The highest portion of the plain lies just west of the line of the Government railway and, therefore, generally within a few kilometres of the Blue Nile. From this there is a pretty rapid slope to the bed of the Blue Nile, but a very gradual slope down to the White Nile.

The plain, as a whole, has, therefore, a gradual slope to the north in the direction of the Blue Nile flow and a gentle slope to the west to the White Nile. The alignment of irrigation canals is, therefore, easy and uniform, which facilitates the division of the land into regular and compact blocks handy for supervision and administration.

Save for occasional shallow depressions which occur locally the plain is remarkably level and regular so that practically no levelling was required. The amount of clearing required has, likewise, been very small, with the exception of certain areas in the extreme south which are covered with light scrub.

It is not easy to grasp from the mere quotation of statistics the vast size of the works necessary for the irrigation of this area.

The length of the Sennar Dam is 3,025 metres, or nearly two miles. It would thus take an hour to walk from one end to the other and back.

LARGE EXCAVATORS.

SMALL RUSTON EXCAVATOR.

The reservoir formed above the Dam will be a lake 50 miles long, and its capacity about 140,000,000,000 gallons, *i.e.*, enough water to supply the needs of Greater London for a period of nearly two years.

The masonry in the Dam weighs nearly 1,000,000 tons, while the weight of ironwork is about 3,300 tons.

The canalised area for the first instalment is about the size of Bedfordshire, while the actual area under cotton will be as half as large again as the County of London.

The total length of canals is 5,954 kilometres (3,697 miles), and of field channels, 9,000 kilometres (5,589 miles), giving a total length of 9,286 miles.

CHAPTER IV.

The Position of the Native Inhabitants under the Scheme.

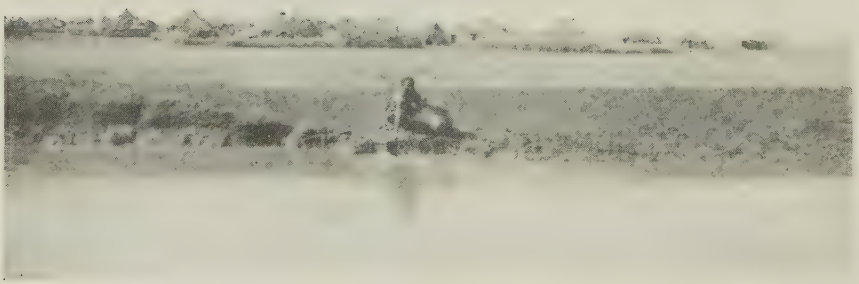
A SHORT description of the area and manner in which the present project has grown was given in Chapter II, but it is necessary to explain more in detail how this has affected the natives who previously lived on cultivated crops in this area. As has been stated, rain cultivation was conducted on a large scale, important quantities of dura and some native cotton being grown. It would have been impossible, however, to give each cultivator the same area as he had previously worked.

Owing to the irregular shape of native owned plots, the boundaries of which were originally determined by earth banks, called terrasses, to hold up water during the rains, it is obvious that it would have been impossible to lay out any irrigation system based on these boundaries. Moreover, the special characteristics on the ground which are necessary for producing rain crops are the reverse of those required for the layout of an irrigated plot, for whereas in the former, the terrass is constructed along the lowest part of the ground, in the latter the canal line should follow the higher levels.

Therefore, not only for the alignment of the canals, but also for the most efficient working of the scheme in rectangular blocks of uniform size, it was essential that the land should be entirely under the control of the Government.

The system which has been adopted for this purpose is as follows. The Government has taken forty years lease from the registered owners of all the land within the scheme at a fixed annual rental of 10 P.T. per feddan. Land for permanent works outside the scheme is purchased by the Government at £E.1 per feddan. These prices are based on the highest prices obtainable for the land before the inception of the scheme.

VILLAGE WELL—SHOWING OLD METHOD OF OBTAINING WATER



VILLAGE ON CANAL BANK—WATER "LAID ON."

After renting the land, it is re-allotted to the actual owners in the form of cultivating tenancies for plots of regular size of 30 feddans each, the owners getting the tenancies allotted to them in positions lying as near as possible to the position of their original holdings.

The whole of the procedure for this purpose was laid down in the Gezira Land Ordinance, of 1921, but the provisions as regards the sale of land by registered owners are further governed by a notice published in the " Sudan Government Gazette," of the 1st February, 1914, to which reference is made below.

The main points to be noted are as follows :—

Under section 10 of the 1921 Ordinance, owners of land within the irrigated area in the Gezira (which for the present may be taken as the 300,000 acres included in the present scheme) are entitled to be granted yearly cultivating tenancies of such size as they themselves are competent to cultivate.

This provision is in practice being interpreted as follows :—No single tenant is regarded as capable of cultivating himself more than a unit of 30 acres, but if he is the registered owner of a larger area he is given the opportunity of nominating tenants to the excess. Thus the registered owner of a total of, say, 90 acres would be entitled to take up one tenancy himself and to nominate cultivating tenants of two other plots of 30 acres each. These nominees are in many cases the owners' sons or relations.

It is too early yet to see exactly how this practice will work out in the course of future development. The Government wishes to treat the freeholders as fairly as possible, but if they own more land than they can cultivate themselves, and consequently nominate tenants to a portion of this area, the Government must see that such tenants, if they cultivate properly, have security of tenure. Just for this purpose the Government, or the Syndicate acting for it, may have to exercise some control, and cannot, merely for the sake of respecting a freeholder's right, allow a tenant who has worked well and got his land into " good heart " to be turned out. This whole aspect of the matter is a somewhat difficult one and is being watched carefully by the Government, whose special commissioners in the area co-operate closely with the Syndicate's inspectors.

In considering the policy in this respect two main points as regards the previously existing conditions must be remembered. First, in years of good rains the larger owners could neither cultivate themselves nor find tenants for the whole of their area, while in years

of bad rains the lands had no letting value. Secondly, there is within the 300,000 acre area a considerable population, who, although not registered landowners, have been dependent for generations on renting a portion of land from the owner. The claim of these people to a livelihood from the land must, of course, be considered by the Government.

The tenancy in each case is a yearly one, but the owner cultivator is entitled to a renewal of his tenancy from year to year, subject only to his complying with the specified conditions of cultivation. He has, therefore, all reasonable security of tenure, and cannot be turned out as long as he fulfils the conditions.

So far every owner of land within the areas already taken up, who applied for it, has been allotted a tenancy, but the " owner " applicants will not exhaust the whole of the area which is available. After these applications have been considered, the Government (or the Syndicate acting as agent for the Government) is free to consider applications from would-be tenants. If a man, who was not previously the registered owner of land in the area, is allotted a tenancy, he has not the same absolute right to a renewal of the tenancy from year to year as an owner-tenant. In practice, however, his position is not much different, and provided only that he cultivates with reasonable efficiency, his tenancy will, in fact, be renewed from year to year. As stated in Chapter II, the total area brought within the scheme for the current season is 200,000 acres. This is divided into 8,000 tenancies of 30 feddans each, and of these about 5,000 tenancies have been taken up by landowners or those nominated by them, and the remaining 3,000 by people either resident in the area or from neighbouring districts.

It is important, moreover, that the position of each cultivator when he becomes a tenant under the scheme should be understood. Instead of being a cultivator on his own land, he is receiving a rent of 2s. per acre for his land and is entitled to cultivate as a tenant an irrigation plot as near as possible to his own original land, and if his own original rights exceeded 30 acres, to put in his sons or other nominees as tenants of other plots up to the full amount of his land. On each plot of 30 acres he is entitled to grow 10 acres of cotton, 10 acres partly of green crop for cattle, and partly of as much grain crop as he requires for his own consumption. Instead of relying on precarious rains he gets regular water supplied through the irrigation

channel. As regards his cotton crop he gets the best seed distributed to him, he has the advantage of all the expensive scientific work which is being done by the Government and the Syndicate for discovering the best preventatives for the insect pests and diseases to which cotton is so subject, and the marketing of his crop is managed to the best advantage so that instead of being at the mercy of local dealers he gets the highest price possible. He gets cash advances at a low rate of interest throughout the cultivating season to cover his living expenses, and he gets the advantage of ploughing machinery to plough his land. Of the proceeds of sale of the cotton crop, after deducting only the actual cost of ginning and marketing, he receives as his share 40 per cent., and further, he has the benefit of any other crops which he may grow free of all deductions or taxes.

As regards the 40 per cent. share of the cotton crop, it is important to point out that this figure is generally in accordance with established native customs prevailing in other parts of the Sudan where irrigation has been customary. The general basis of all such customs is that a bull on a water wheel is equivalent to a man, in other words, that half the crop goes for labour and half for raising the water. But this division takes place after payment of rent and taxes, all of which, in the Gezira scheme, are included in the 60 per cent. paid by the tenant. In addition, his green crop and grain crop is free of all claims, so that in effect he is far better off than the normal cultivator under local conditions.

It has been explained above that in order to divide up the land into holdings of regular shapes suitable for an irrigation scheme it was necessary for the Government to take a lease of the land in the area to be irrigated from the registered owners for forty years. Throughout the period of renting, however, the native owner retains the freehold interest in his land, which he can still bequeath by inheritance to his heirs according to Mohammedan law. Further, when the period of lease is over, the full use of the land, with all the benefits of development, will revert to the freeholders. In order, however, to prevent any kind of land speculation or the alienation of land by the natives to foreigners, and also to protect the cultivator from the native usurer the Government has taken certain powers to limit sales. Under one of the first proclamations issued by the Sudan Government, on the 1st April, 1900, it was laid down that contracts for the purchase of land in any province had to be submitted to the Governor of the province for approval. According to

a notice published on the 1st February, 1914, which followed earlier notices on the same subject, it was definitely declared that the consent of the Governor of the province would not be granted to " any sales or dispositions by the natives of the Sudan of lands *in the Gezira* effected after the 1st July, 1905, *except of such sales to other natives of the same locality as have hitherto been customary and may be deemed by the Governor to be proper.*"

In practice, and in accordance with the above, the settled policy of the Government as regards land in the Gezira since 1905 has been to refuse sanction to all transactions except genuine sales in the ordinary course from one native to another. The result of this policy has been that practically the whole of the land in the Gezira remains in native ownership divided into comparatively small holdings. The chances of land getting into the hands of the foreign land speculator have thus been reduced to a minimum. This policy has also prevented the growth of a class of wealthy native absentee landlords. In fact, the whole of the land remains in the ownership of the actual cultivators who work upon it, and for all practical purposes this condition is preserved by the terms of the new irrigation scheme.

CHAPTER V.

Administration.

THE whole of the present scheme is within the boundaries of the Hassheissa, Wad Medani and Sennar districts of the Blue Nile Province.

The ordinary administrative organisation of the districts is unaffected by the scheme, but all administrative questions definitely arising out of the changed conditions in the area are dealt with by two special Commissioners for the Gezira on the Province headquarters staff.

Their duties are laid down in the Gezira Land Ordinance. They, in fact, act as a connecting link between the administrative staffs of the Syndicate and the Government, and are responsible for seeing that the interests of the natives are safeguarded in accordance with the terms of the Ordinance.

The Syndicate organisation consists of :—

(*a*) Headquarters staff, at Barakat, some six miles south of Wad Medani, and

(*b*) An inspectorate staff spread over the irrigated area.

The whole is under the control of a managing director at Barakat.

The area is divided into 19 blocks of irregular shape, but of an approximate area of 15,000 feddans each.

The six southern, five central and eight northern blocks are treated as groups, each of which is under a senior inspector, while each block is again under a block inspector with two or three junior inspectors to assist him.

The authority of these inspectors does not extend beyond the agricultural supervision of the tenants. They have no punitive powers and their functions in no wise conflict with the authority of Omdas and Sheikhs. The latter, on the other hand, are often of great assistance to the Syndicate inspectors, and a Sheikh of character has ample opportunity for asserting his position and thereby increasing the respect of those under him.

The question of the reactions on the social life and general well-being of the native population which may be expected from the creation of new economic conditions as a result of the scheme, has

SYNDICATE INSPECTOR'S HOUSE.

received the careful consideration of the Government. Although each tenant has a small living hut on his holding in which he spends the bulk of his time during the active periods of work (in the picking season) he also retains a house in his village where most of the members of his family reside and which he visits constantly. The house in the village is his permanent home, and his habits and conditions are very similar to those which have prevailed for hundreds of years among the sagia cultivators in the northern provinces, where the cultivator often has a sagia two miles away from his village, and divides his time between his hut on his sagia and his house in his village.

The village organisation is, therefore, still retained and no village has had its common land reduced in area owing to the alignment of canals.

Sanitation.—One of the most serious problems that the Sudan Government has had to consider in connection with the Gezira scheme is the risk of malarial conditions being introduced with the irrigation, and on this point it shall be noted :—

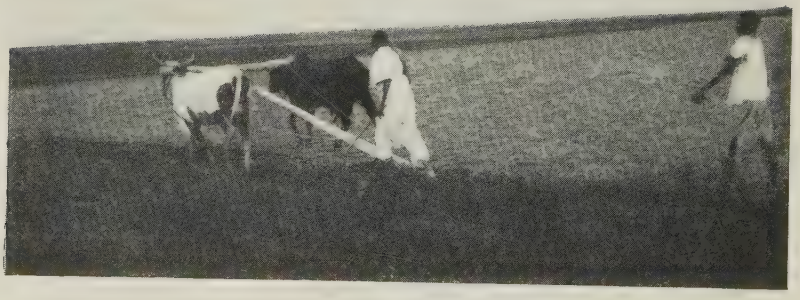
1. That under the old conditions of cultivation by rain there was no control of the water, and that breeding places for mosquitos were constantly formed in pools under terrass banks or in larger depressions.

2. That under new conditions there will be no terrass banks with pools under them, and that the canal banks will very much diminish the amount of the water which will flow into depressions.

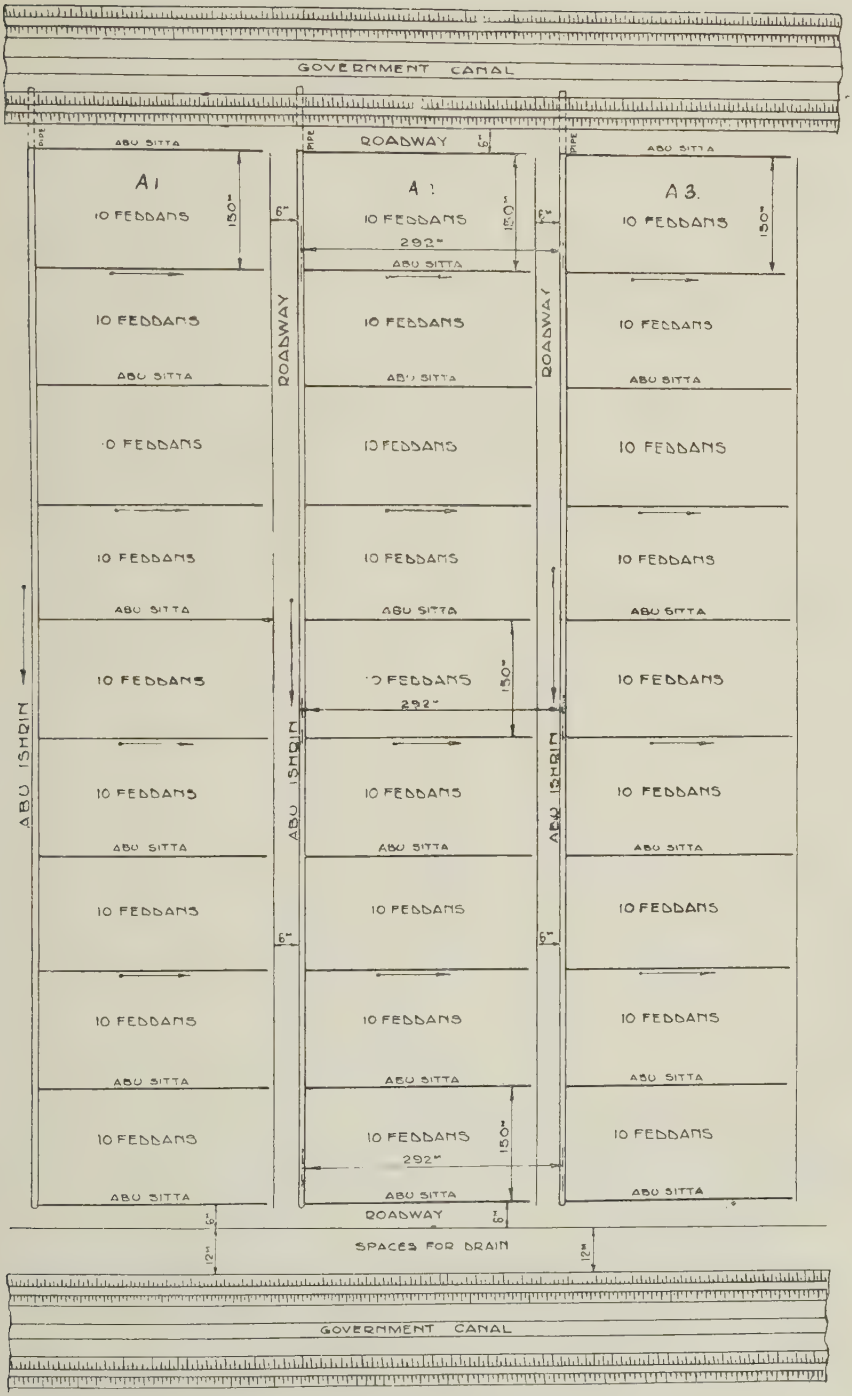
3. That, generally, the whole system will be under control, and that a controlled system with adequate staff is far less likely to give trouble than the old state of affairs with no control and no staff.

4. An organisation has been established for dealing with malarial conditions and providing treatment for patients. In each block there is a dispensary with a Tumergi (hospital attendant) and a native sanitary official. They are all supervised by the medical inspectors at Wad Medani, who have the assistance of the British sanitary inspector when required. All the Syndicate inspectors, whose interest it is that their tenants should keep as well as possible, have had instructions as to all points likely to produce malarial conditions, and it is part of their duties to be on the look-out for such conditions and to remedy them at once. Stagnant water on the land, which is the main danger, is not only undesirable from a sanitary point of view, but is bad for the land and the crop, and it is definitely in the interest of the Syndicate to prevent this.

STEAM PLOUGHING.



NATIVE PLOUGH.



PLAN SHOWING NINE TENANCIES.

CHAPTER VI.

Agricultural Considerations.

IT has been decided that cotton will be cultivated in a three course rotation, that is, the same land will carry cotton only once in three years. In the 300,000 feddans there will, therefore, be 100,000 feddans under cotton in each year.

Each tenancy of 30 acres is divided into three areas of ten acres each, and is in itself a miniature irrigation scheme.

The plan on page 27 shows the holdings of nine tenants between two Government canals.

Each holding extends lengthwise across three field channels or "Abu Ishreens."

The system, as shown, is irrigated by water which flows from the topmost canal and is conducted to the "Abu Ishreen," running alongside the tenancies by means of pipes under the roadway, thence on to the land by means of the smaller cross channels or "Abu Sittas."

Taking the uppermost tenancy the rotation would work out as follows :—

1st season—A 1, cotton ; A 2, fallow ; A 3, leguminous and/or grain crop.

2nd season—A 2, cotton ; A 3, fallow ; A 1, leguminous and/or grain crop.

3rd season—A 3, cotton ; A 1, fallow ; A 2, leguminous and/or grain crop.

(Diagram here attached.)

Soil.—The soil of the Gezira is a stiff loam, containing some 55 to 60 per cent. of clay. It is of a dark colour, especially towards the southern end where the rainfall is heavier. During the rains it swells in an extraordinary manner and contracts when the hot dry spell sets in, giving rise to enormous cracks and fissures. The same

SOWING.

RIDGING.

applies to a less extent when the land is artificially irrigated. It readily becomes impervious to water so that no serious loss by seepage through canal banks appears to occur.

Seed.—Sakellaridis long staple Egyptian cotton is sown exclusively.

METHOD OF CULTIVATION.

Cultivation.—The land is cultivated by machinery well ahead of the ensuing crop, ploughing beginning as soon as the rains have ceased. The land is then ridged and cross channels are cut, the ridges being mended by hand.

Sowing.—Sowing and resowing takes place from July 15th to September 15th. The seed is dibbled in at the rate of 1.2 to 1.5 kelas (1 kela—18 lbs. of cotton seed) of seed to the feddan.

The distance between the rows is 80 to 90 c.m., and between the plants in the row 40 to 60 c.m. The seed is sown on the tops of the ridges.

Irrigation.—Watering is given every 12 to 18 days, depending on the time of year—the waterings being rather more frequent in October with wider intervals in the colder months of December and January. Water is supplied on or shortly after July 15th at the rate of about 450 cubic metres per feddan every 15 days. Some fourteen waterings are given in all.

Dura cultivation depends mainly on the rains, but sufficient water is given to ensure the ripening of the crop. This is given either at the time of sowing at the beginning of August or later on at the end of September or beginning of October, according to the circumstances of each year and the actual rainfall on any particular plot.

Lubia receives some four waterings at twenty-day intervals, beginning in September.

Thinning.—When a few inches high, the plants are thinned, and two plants left in each stand.

Tarading.—This consists in ridging up the land so as to facilitate water control.

Weeding.—This is done by hand and becomes necessary directly watering begins.

Flowering.—Flowering begins in September and goes right on till the plants are finally cut out ; in absence of a cold season there is no automatic cessation of flowering as in Egypt and elsewhere.

CULTIVATING.

PICKING.

This continuous flowering makes it very difficult to estimate during the season how the crop is going to turn out.

Picking.—Picking begins in late December or early January and is finished by the middle of May.

Destruction of Old Stalks.—When picking is finished all cotton stalks are cut down and burnt on the field to minimise the risk and danger of pests—under existing regulations this has to be finished by May 31st.

Yields.—The following table shows the yields in kantars of 315 rotls :—

Year.	Tayiba.	Barakat.	Hosh.	Wad el Nau.
1911–12 ..	5.32	—	—	—
1912–13 ..	5.62	—	—	—
1913–14 ..	3.80	—	—	—
1914–15 ..	3.10	5.39	—	—
1915–16 ..	3.10	3.48	—	—
1916–17 ..	3.47	3.20	—	—
1917–18 ..	4.10	2.66	—	—
1918–19 ..	4.13	3.50	—	—
1919–20 ..	5.60	4.98	—	—
1920–21 ..	3.20	3.50	—	—
1921–22 ..	3.46	3.84	4.23	—
1922–23 ..	4.30	4.00	3.4	—
1923–24 ..	2.54	2.87	2.88	2.88
1924–25 ..	2.338	2.288	2.390	2.046*

Ginning and Marketing.—The cotton is ginned at the Syndicate factory, near Barakat, shipped to England, via Port Sudan, and marketed at Liverpool.

Pests.—The diminution in yields during the last few years is due partly to the extension of cotton growing over a larger area, but largely to the increase in the damage done by pests, of which black arm and thrips are the most formidable. Black arm (*Bacterium Malvacacearum*) is a bacillus which is known to be carried by the seed. It flourishes under conditions of excessive humidity and it is not yet known whether the seed is the only possible source of the disease. It kills off seedlings and causes defoliation to full grown plants. It gives rise to immature weak short staple cotton and a heavy decrease in yield.

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* Wad el Nau yields in 1924/1925 were lower than elsewhere as watering stopped at Wad el Nau on March 31st instead of April 15th as in the case of the other pumps.

COTTON PICKERS.

CLEANING COTTON.

Thrips (*Heliothrips Indicus*) is an insect pest which appears towards the end of the rainy season. It perforates the leaves to such an extent that defoliation is caused. Heavy frequent watering has proved effective in combating it.

Both black arm and thrips affect weak plants more than healthy ones and the real problem is how best to produce strong growing plants with a high power of resistance to disease. Fortunately, the two diseases do not coincide as regards their worst periods, and there is only a short period when heavy watering of thrips is likely to produce conditions of excessive humidity favourable to black arm.

Other insect pests which, though not less serious, are more amenable to control are pink boll worm and stemborer and Egyptian boll worm.

GEZIRA RESEARCH FARM.

In conjunction with the Empire Cotton Growing Corporation, and the Sudan Plantations Syndicate, Ltd., the Government has made arrangements for the carrying on of a comprehensive programme of scientific research in connection with the agricultural problems which have arisen, and are likely to arise in the future.

An advisory committee has been set up in London in which the bodies mentioned above are represented, whose duty it will be to consider the annual reports upon agricultural research carried on in connection with the Gezira scheme, and to consider and advise regarding the programme of research work for each year which will be submitted to them.

The Gezira Research Farm, near Wad Medani, will be the main centre for work in this connection. This farm, which extends to some 350 feddans, has been planned and equipped to deal with the investigation of the problems that will be encountered in the agricultural development of the Gezira area. A staff of scientific workers is established there and laboratories have been built and equipped in which work in connection with various chemical, botanical and entomological studies will be carried on. On the various plots into which the farm has been divided, experiments are being carried out in connection with crop rotations, varieties of cotton and other crops, systems of cultivation, &c.

Seed Farm.—In order to maintain the quality and uniformity of the cotton grown, a seed farm has been established by the Sudan Plantations Syndicate in collaboration with the Sudan Government.

SACKING

CARRYING COTTON.

An area of some 900 feddans has been devoted to the raising of cotton from which high-grade seed for the general crop will be obtained. Seed of an approved pure strain is sown on a small area under very careful supervision, the plants produced being subjected to close examination. Any plant not up to the standard set is pulled out, and seed only kept for sowing from those which in growth, yield and quality come up to a high standard.

Seed from this plot is to be used for the sowing of larger area, which will be subjected to similar scrutiny and rogueing of all plants not up to type until a sufficient bulk of seed is obtained for sowing under ordinary conditions throughout the irrigated area. By this means a supply of pure seed of approved quality will be constantly passing out from the seed farm to the ordinary cultivation, the seed obtained from the main crop being exported for crushing.

Livestock.—It is hoped that as the scheme progresses the number of livestock that it will carry will be considerably increased. Experiments as to the amount of stock that each tenant can feed from his crops are being carried out and the importance of this question is fully realised. Not only will it increase the wealth of the population, but it is obvious from all work that is being done at the Experimental Farm that farmyard manure is the best fertiliser that can be procured, and that the larger head of stock that can be kept on the land the higher the cotton yields are likely to be.

DISTRIBUTARY CANAL

ABU ISHREEN TAKING OFF DISTRIBUTARY CANAL.

CHAPTER VII.

The Plan of Irrigation for the Gezira.

AS originally projected by Mr. C. E. Dupuis, as the result of studies initiated by Sir William Garstin in 1905, the scheme for irrigating the Gezira provided for a low level weir across the river at Sennar with a canal leading off it at a low level.

The function of the weir was to have been to maintain the river at about the normal flood level at all periods of the year.

The scheme contemplated no storage of water, and the supply was to be drawn down the main canal, taking off upstream the weir from the normal river supply at all times of the year.

The area served was to have been 100,000 feddans, but this figure was subsequently increased to 200,000 feddans.

The main supply canal was to have run on the low ground near the river, and, following the contours of the ground, would have commanded the Gezira plain at about Wad Medani, thus making the length of the supply canal about 100 kilometres.

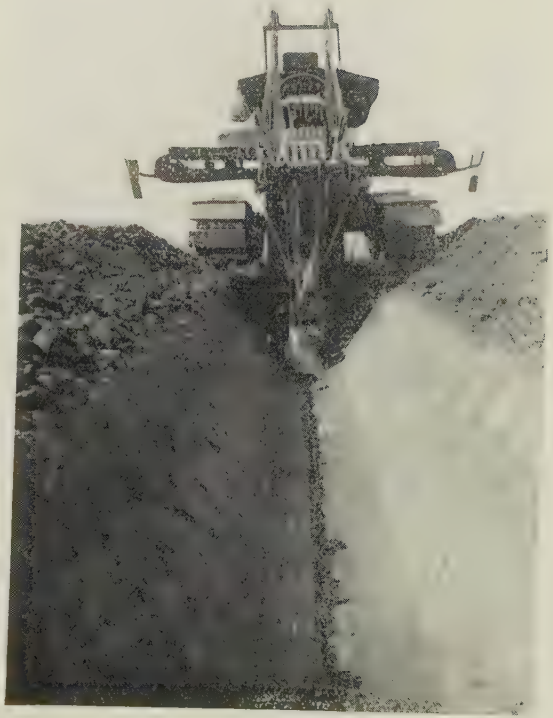
This original plan, however, was modified before any work was started, for the following reasons :—

The area to be cultivated was increased to 300,000 feddans.

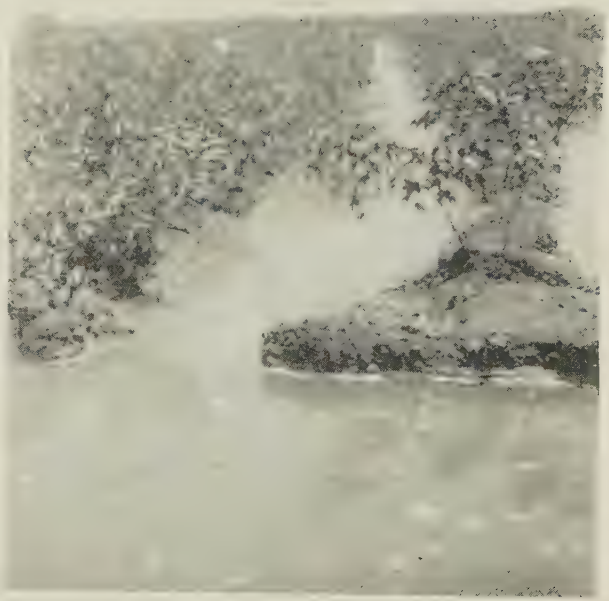
The additional area and the experience of the low river supply of 1913–14 indicated the necessity of storage of water during the latter part of the cultivating period.

The modified scheme enabled the main canal to command the Gezira plain at 57 kilometres from the Dam, and some 40 kilometres south of Wad Medani.

The result of shortening the main canal and running it at a higher level was that the necessary earthwork was proportionately reduced and that the design was more suited for any expansion of area.



BUCKEYE EXCAVATOR DIGGING ABU ISHREEN.



ABU SITTA.

DAM.

The scheme, as constructed, consists of a granite masonry Dam of a gravity section, situated some seven kilometres south of Sennar village, and is founded on Gabbro rock which at this point runs across the river.

At the west end of the Dam, sluices have been constructed to feed the main canal ; these are designed to discharge up to 175 metres cube of water per second under the worst conditions.

The Dam is designed to pass a discharge of 15,000 metres cube a second through the sluices. This is 20 per cent. in excess of the greatest known discharge of the Blue Nile in flood.

Canalisation.—The scheme of canalisation consists of a main canal, major and minor distributary canals, and field channels.

Major Canals.—The main canal itself is 114 kilometres long, and at five points regulators have been constructed to control water levels. At each of these points distributary canals branch off from the main canal. The major distributaries again split up into minor distributaries which supply water direct to the field channels.

The principal function of the main canal and the major distributaries is to supply the minor distributaries. As far as possible direct irrigation is only done from the minor channels.

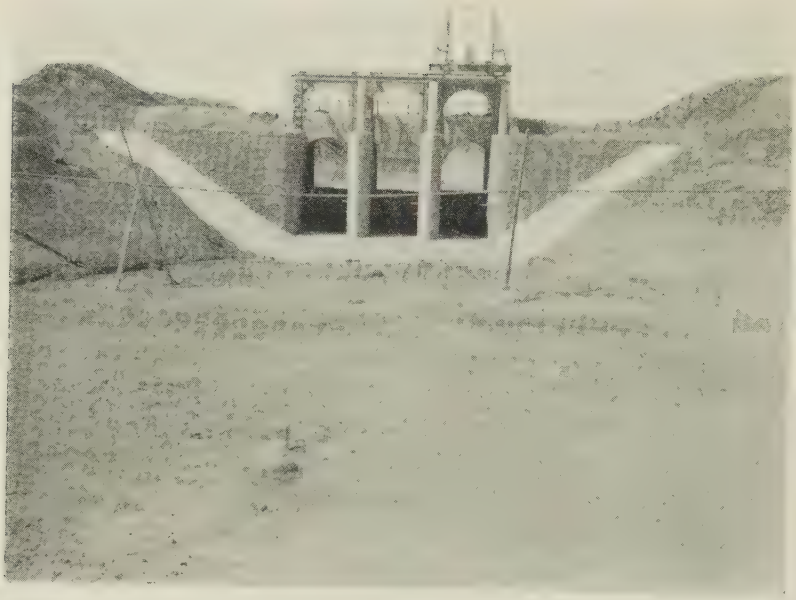
Field Irrigation.—Irrigation of the land is effected by flooding the fields from cuts made in the banks of the field channels. These are of two kinds :—

(1) Minor (Abu Sitta) from which the field is flooded directly. One Abu Sitta being provided for each 10 feddans.

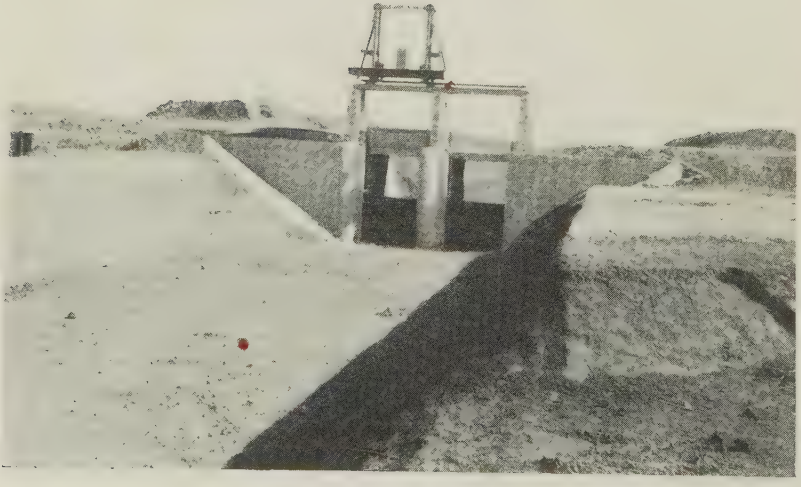
(2) Major (Abu Ishreen) which draw directly from the Government canal (distributary) and feed water to the Abu Sitta.

The latter channels usually run at right angles to the Government canal and serve 90 feddans. They occur at intervals of about 300 metres along the Government canal and are some 1,350 metres long. They are provided at the head with a pipe (.35 metres diameter), fitted with a regulating valve under the bank of the Government canal, from which they draw water.

Areas.—The total area included within the boundaries of the scheme is some 345,000 feddans, of which 300,000 are available for cultivation, the balance being occupied by canals, drains, roads, villages and areas unsuitable for cultivation.



LARGE REGULATOR.



SMALLER REGULATOR

DESCRIPTION OF MAIN CANAL.

The water at the head in the main canal, near the Dam, is some 4 metres below the level of the Gezira plain. There is an average fall of the land along the line of the main canal of 14 centimetres per kilometre.

The main canal is designed to run with a fall of water of half this amount, *i.e.*, 7 centimetres per kilometre, so that at 57 kilometres from the Dam the water in the main canal is above the level of the plain and can run freely on to the land and irrigation is possible.

Water Control.—At this point there is a masonry regulator in the main canal for the control of water. It consists of six openings, each 3 metres wide, fitted with moveable steel gates. By means of these gates it is possible to adjust the water levels upstream, the regulator as required, and to take measurements of water discharged through the regulator by direct measurement on the gates themselves.

Three major and two minor channels take water from the main canal upstream of this regulator.

The three larger branches are fitted with masonry weirs the crests of which are all at the same level.

The widths of these weirs are each made proportional to the area served. Thus, when water is passed into the various canals over these weirs it is automatically divided in proportion to the area served by each canal. However, the water requirements are not constant, but vary according to the time of year and crops in the ground, and in order to meet the variation in demand all that is necessary is to raise or lower the water in the main canal to the extent required by means of the gates on the main regulator—a very simple operation.

At three other points on the main canal downstream these regulators occur, and the arrangement described above is the same.

At the tail (kilo 114) the main canal bifurcates into approximately two equal areas and a different arrangement is adopted. The two regulators at this point are provided with moveable steel gates, on which discharge measurements can be obtained by direct measurements on the gates, and by this means water is correctly distributed.

Owing to the length of the main canal, and adjustments made in the discharge coming in at the head take a considerable time to be effective in the lower reaches where the water is being used, and to permit of sudden adjustments in discharge into the branch canals

owing to rain storms, breaches in canals or errors in regulation, four escapes have been provided which will pass surplus water back from the main canal into the river.

For control of water in the distributaries the following method is adopted.

The whole area is divided up into blocks of about 15,000 feddans, and at the point where a canal enters a block, the water entering the block is measured, either over a masonry weir or by direct measurement on a regulating valve.

As the area served is known the discharge can be checked and adjusted to give the correct quantity.

The whole of the regulation of water, when more than one agricultural block is affected, will be controlled by the Irrigation Department, but the distribution of canals which lie wholly within any one agricultural block will be controlled by the agricultural inspector in charge of that particular block.

There are difficulties in irrigating crops at night, and continuous irrigation is not possible. Arrangements have therefore been made by which all field channels will be closed for a certain number of hours at night.

No variation between night and day supply is possible in the main canal and major distributaries, but the minor distributaries are, under certain conditions, able to store the amount of water necessary. The method adopted is this.

The discharge from the major into the minor distributaries is kept constant. The minors are divided up into a varying number of reaches by means of regulators. These regulators consist of a sluice valve built into a masonry wall. During the day time the sluice valve is adjusted to maintain the required discharges and levels for irrigation in the canal.

Before irrigation ceases at night the water in the minor distributaries has run off to a certain fixed level in each reach. The field channels are closed and the regulator sluice is then closed, and the water allowed to accumulate in the channel. The wall in which the regulating sluice is constructed is made to a fixed level (which depends on and is below the bank level of the canal). The sluice having been closed the water rises in the reach up to the level of the top of the wall and then discharges over the top into the next reach. Thus the process becomes automatic and each reach fills up to a desired level which cannot be exceeded.

Control at the Dam.—The general scheme for controlling the water required for the scheme was drafted on the following lines.

At the commencement of the irrigating season (July 15th) the water in the river upstream the Dam, at Sennar, will be gradually raised, and the main canal allowed to draw water until July 31st ; the river has risen 2.70 metres and the main canal is able to draw the full discharge required for irrigation.

The river will be maintained at this level until the end of October, by which time the flood (which reaches its maximum early in September) is falling away rapidly and is practically free from depositable silt.

The filling of the reservoir will take place in November, the water being raised a further 3.70 metres, and maintained at full reservoir level till about the middle of January.

After this, until April 15th when irrigation ceases, the Gezira canal will draw its supply from the reservoir and not from the river, and the water level in the reservoir will consequently fall. The whole of the natural flow of the river will be passed on through the Dam.

Control of Canals and Water Requirements.—On July 15th the main canal is opened and sowing and irrigating is commenced. The first watering is a heavy one, but the amount of water consumed very quickly falls away, though it varies in accordance with the rainfall.

The demand again rises in October and the main canal will draw its maximum supply in October and November. As the weather cools down the demand for water falls away.

In the middle of January, when the canal must begin to draw on the reservoir, irrigation of crops other than cotton will cease, the supply into the main canal being consequently reduced. Thereafter, with hotter weather, the demand for water increases until the cotton reaches maturity in the middle of April, when irrigation ceases.

On April 15th the main canal will be closed down and a small amount of water, estimated at 10 cubic metres per second, will be drawn from the water stored in the reservoir and distributed throughout the area for domestic and drinking purposes until July 15th, when cultivation again commences.

SENNAR DAM, NEARING COMPLETION.

Canalisation Statistics.—The total length of canals constructed by Government in the present scheme is 1,252 kilometres, of which the main canal is 114 kilometres.

The total length in field channels is :—

Major	..	4,500 kilometres.
Minor	..	9,500 „

The size of the main canal for the first 57 kilometres is :—

Depth of water	..	3.4 metres.
Width at bottom	..	26 „
Width at water surface		33 „

The main canal is designed to discharge $7\frac{1}{4}$ million cubic metres of water per day.

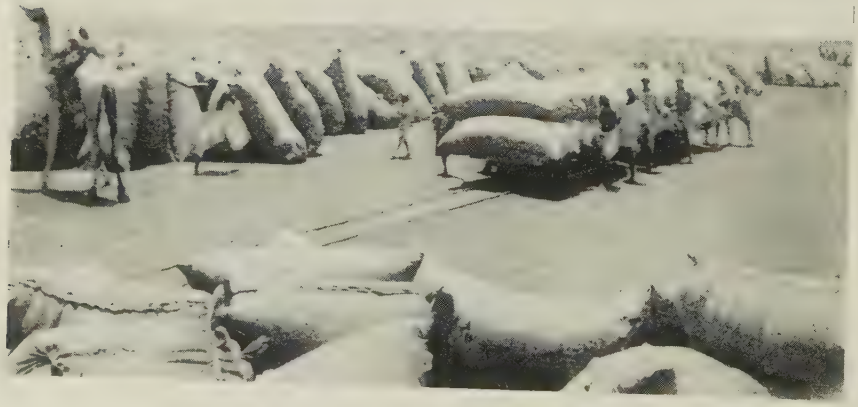
The amount of water required for unit areas of crops at various periods of the year is known approximately from the experimental pumping stations, and the quantity of water which will be passed into the main canal, and from the main canal into the distributaries, will be on the basis of these figures and the area of land under crop, and will be modified from time to time according to climatic and other conditions.

The discharge into the main canal at the head will be controlled by direct measurement, but as already described, at the various control points on the main canal, the division of water will be effected by variation of the level upstream the regulator ; the levels which give the various amounts of water being already known and very accurate division of water will be obtained.

The discharge of water into the distributaries is carried out by direct measurement on the sluice valve, and great accuracy will be obtainable, but division of water will not be automatic.

The quantities of water dealt with in the distributaries is much smaller and adjustments are more easily effected, and the same degree of accuracy in distribution of water will not be so necessary.

COTTON COLLECTING STATION.



COTTON OUTSIDE GINNING FACTORY.

CHAPTER VIII.

Economic Questions.

IN considering the economic effect of the Gezira scheme it is important to consider what was the position of the inhabitants of the area under old conditions. The precarious position of the individual owing to the uncertainty of the rainfall has been fully realised above, but it is interesting to consider the total production of the area under old conditions, as compared with future conditions. It is estimated that the average annual production in the past of the area comprised in the present scheme was 20,000 tons of dura worth £E.100,000. In the future the amount of dura produced will be not far short of this. There will be lubia which will support the animals of the district, and an immensely valuable cotton crop. Taking the dura first it may be noted that in the 1924–1925 season, over most of the area covered by the pumping schemes, four feddans of dura were grown in each tenancy, the rest of the ten feddans block being under lubia. In 1925 this has been altered to five feddans each of dura and lubia. It is estimated that the average yield of dura so cultivated may be put at $2\frac{1}{2}$ standard ardebs per feddan or $12\frac{1}{2}$ ardebs per tenancy (at 80 to 90 P.T. per ardeb).

On this basis, the production of grain over the whole area, when included in the scheme, will amount to 25,000 ardebs, equal to a little over 17,500 tons.

It is not, however, intended that there should be more than sufficient to supply the domestic needs of the tenants, and what was formerly exported to obtain a return in cash, will be replaced by cotton which will be the cash producing crop of the Gezira.

The important point as regards grain production is that in a year of bad rains the production will be far greater than in the past, and in famine years, by increasing the five feddans to 10 and dropping lubia for a year, there would be an addition of 150,000 standard ardebs.

GINNING FACTORY.

INSIDE VIEW OF FACTORY

As regards cotton, with a yield of three kantars a feddan, the irrigated area will produce 300,000 kantars equivalent in value to £E.1,800,000, taking cotton at £E.6 per kantar (*i.e.*, about 14½d. per lb.). Present prices are, of course, very much higher than this. The cultivators' share of this crop would be worth £E.720,000. In addition to this the area generally will benefit from expenditure by Government and the Syndicate out of their share of the crop, and it is probable that the total local circulation of money due to production in the area would be little short of £E.1,000,000 a year, as compared with £E.100,000 under old conditions.

It is difficult to estimate the actual profit of the cultivators, as that depends so much on the amount of labour done by each individual, but if the value of each man's labour is accounted for in his expenses it is probable that the total profit will be not less than £E.350,000, as opposed to not more than £E.20,000 under old conditions.

Actually, owing to higher cotton prices and in many cases higher yields, profits up to date have been on a considerably larger scale. A few typical cases of individual accounts are given below. The advances by the Syndicate represent sums advanced to the tenant during the year to cover the value of his own labour or labour hired by him. Thus, they represent considerably more than actual out of pocket expenditure, where the tenant and his family have worked well themselves and only hired labour when it was absolutely necessary.

"A" was a tenant at Hosh on bad land, and for three seasons his results were as follows :—

Season.	Crop in kantars.	Value of Tenants' share of cotton.	Advances.	Profit.
1921–22 ..	18	£E. 52½	£E. 25	£E. 27½
1922–23 ..	18	47	23½	23½
1923–24 ..	23	80	40½	39½

"B" was a tenant on better land, and his results were as follows :—

1921–22 ..	50	£E. 136	£E. 73	£E. 63
1922–23 ..	39	99	43	56
1923–24 ..	45	159	Nil	159

(In this last season he financed himself from his profits in the previous year. At the end of the third season this individual abandoned cultivation and took to trade.)

"C's" results were as follows:—

Season.	Crop in kantars.	Value of Tenants' share of cotton.	Advances.	Profit.
1921–22 ..	50	£E. 159	£E. 80	£E. 79
1922–23 ..	25	63	28	35
1923–24 ..	26	82	Nil	82

(Again he financed himself in the third season with the profits of the previous one.)

The question of the amount of work that will be done by the tenants themselves is all important. If the tenants and their families work to the fullest extent possible, they should be able to do the whole of the ordinary work of the scheme, rather than half of the heavy cleaning after the rains, and rather less than half the picking. This means that a minimum of 10,000 people outside the tenants and their families will be required in the picking season, and a minimum of about 5,000 in the heavy cleaning season. If the tenants, as they get more prosperous, try to hire labour to an increasing extent and cannot be relied on to work themselves the numbers required would be nearer 25,000 and 10,000. It is practically certain that more casual labour than is required under the above minimum estimates can be found without serious difficulty for the 300,000 scheme, and for an extension to the north where population is comparatively thick. But if the numbers required are in the neighbourhood of the larger figures the effect on labour rates may be serious and the pace at which the scheme can be extended may be seriously retarded. The casual labour comes from two main sources—firstly the Fallata pilgrims—secondly villages in the rest of the Blue Nile Province and in the White Nile Province where the rains have been bad in any one year. There are also a few persons from Darfur and other parts of the country, but their numbers are comparatively small. As the scheme expands the second source of supply will be reduced and Fellata labour will become more important, unless new sources arise. This, however, is a question which it is difficult to discuss usefully until we see the effects of the present scheme.